Advanced Fuel Cycle Initiative (AFCI)

Semi-Annual Review Meeting
Sherator Hotel, Albuquerque, New Mexico
January 22-24, 2003

John W. Herczeg

Office of Nuclear Energy, Science and Technology
U.S. Department of Energy

Evolution of the U.S. Transmutation Program

FY 2000-2003

Accelerator Based Transmutation

ATW

- Conceptual Design
- Independent advisory sub-committee under NERAC established (Richter Committee)

FY 2000

Accelerator & Reactor Based Transmutation

AAA

- System Approaches
- Fuel & Separations
- Accelerators/Advanced Materials
- International Cooperation

FY 2001/2002

Reactor & Accelerator Based Transmutation

AFCI

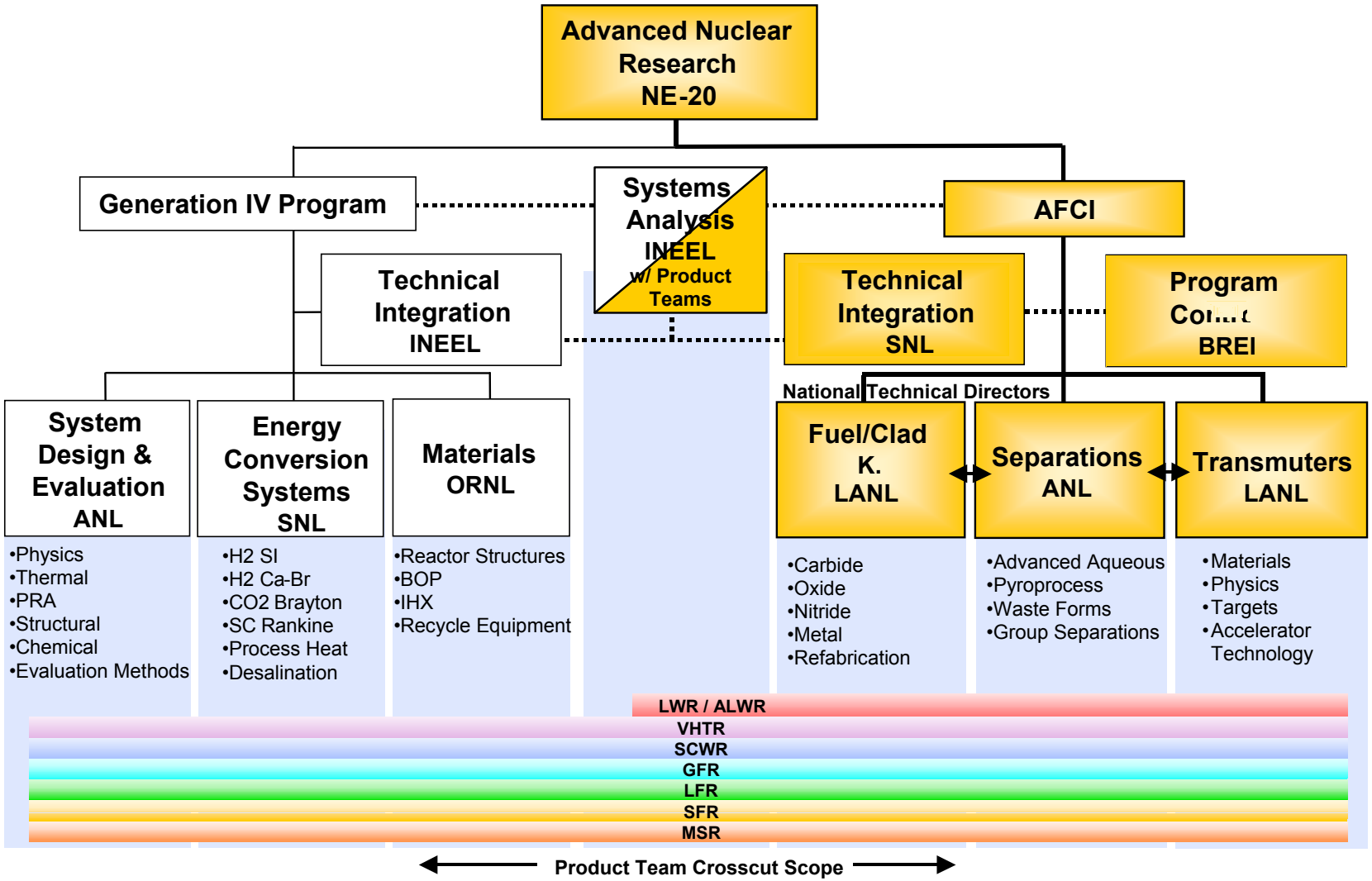
- Advanced Separations Technology
- Advanced Fuels Development
- Toxicity Reduction
- International Cooperation

FY 2002/2003

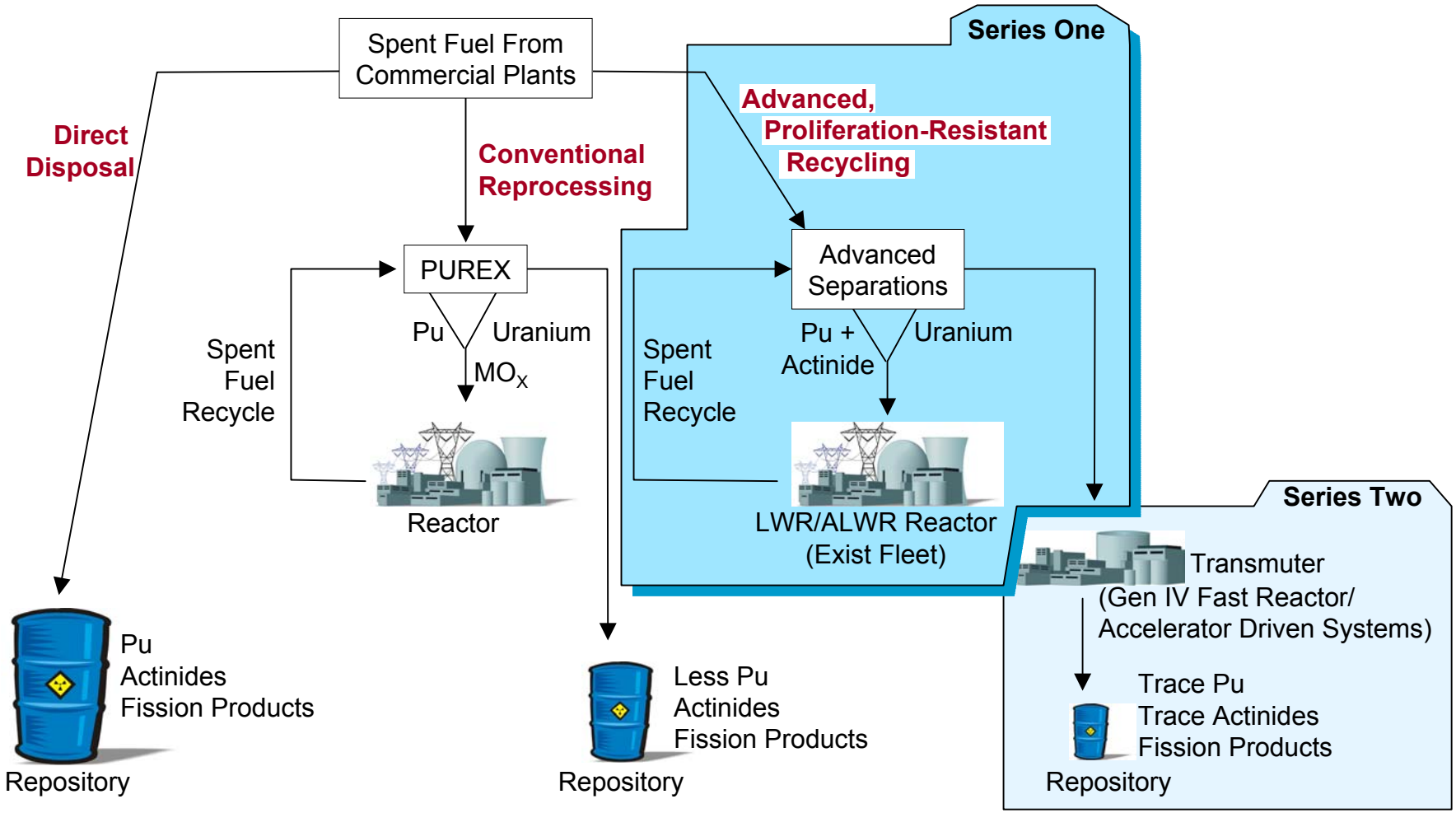
Goals of AAA/AFCI Program

- Reduce High-Level Waste Volume => reduce cost of geologic disposal
- Recover the energy value from spent nuclear fuel => costs off-sets
- Reduce inventories of civilian plutonium
- Reduce the toxicity of high-level nuclear waste requiring geologic disposal
- Reduce short-term and long-term heat load on the repository
- Eliminate the technical need for a second geologic repository

AFCI/Gen IV Organization



Approaches to Spent Fuel Management



Recommendations of ANTT - Chaired by Nobel Laureate Burton Richter

- **Systems Analysis Studies - analyzed reactor-based transmutation systems with/without accelerator systems**

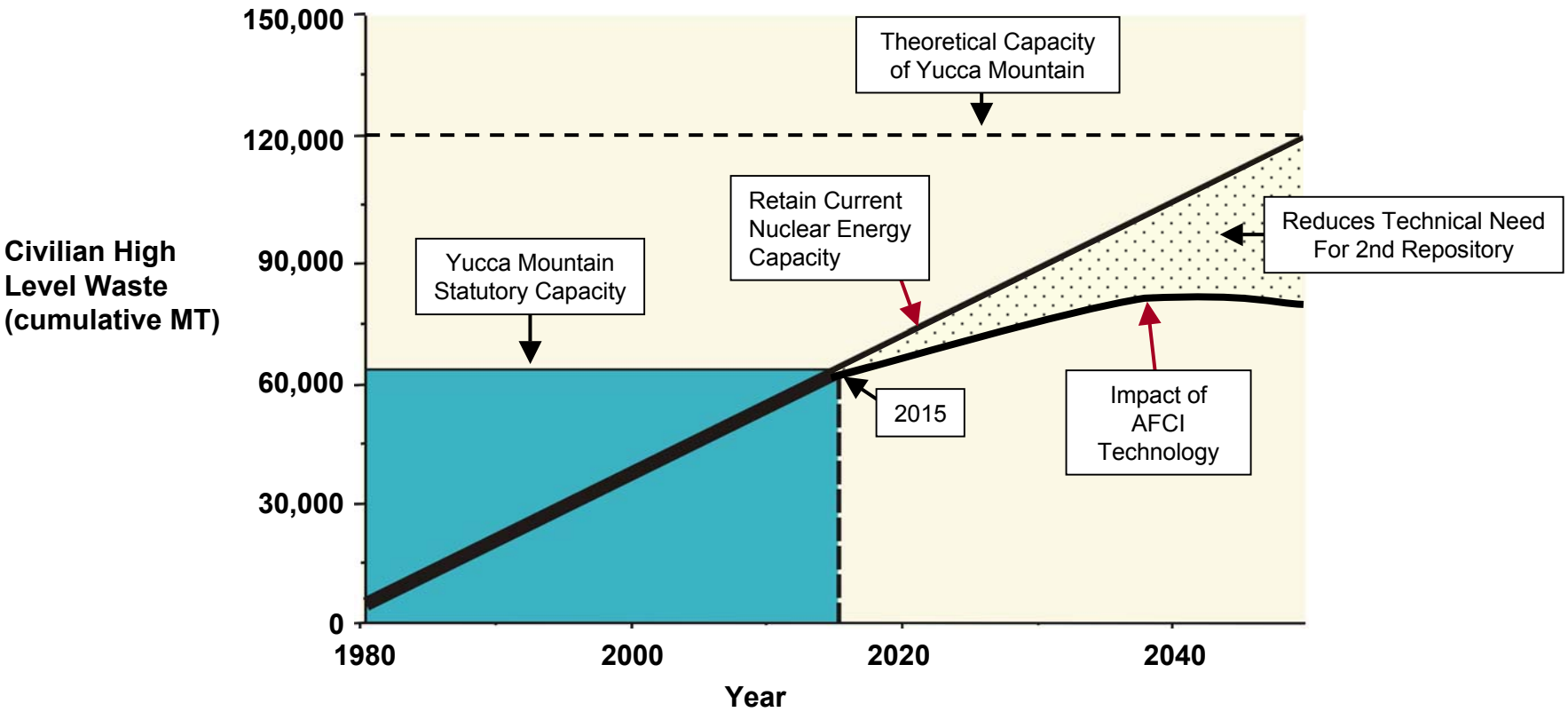
- **Programmatic Phased Approach:**

  - Phase I: "Basic Technology Evaluation" - complete in FY 2002

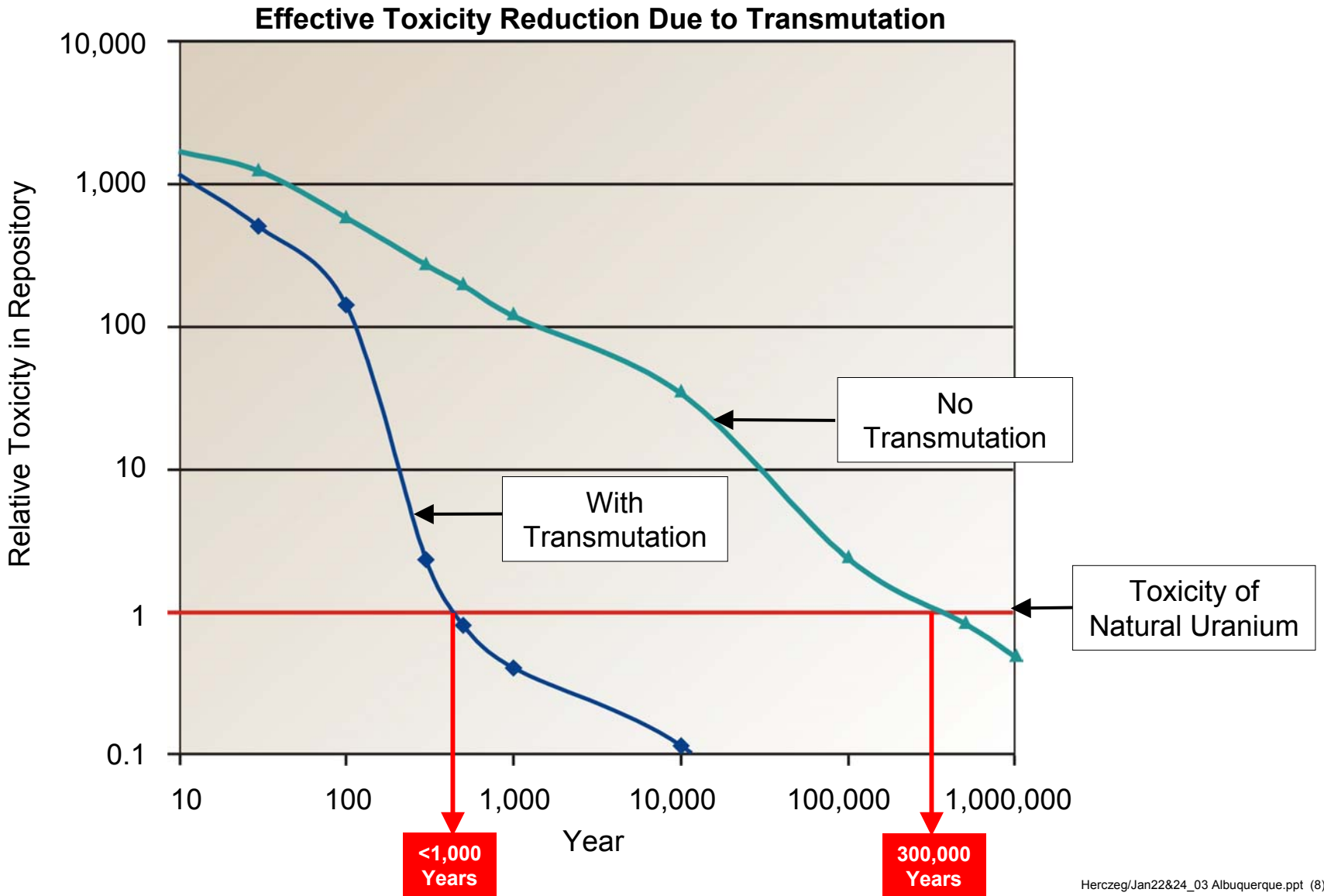
  - Phase II: "Proof-of-Principle" - 5-6 year R&D program ($100M/year) to identify technologies to provide decision makers with options for future path forward, including cost and schedule

  - Phase III: "Proof-of-Performance" - scalable demonstration; 15-20 years

Advantages of Advanced Fuel Treatment

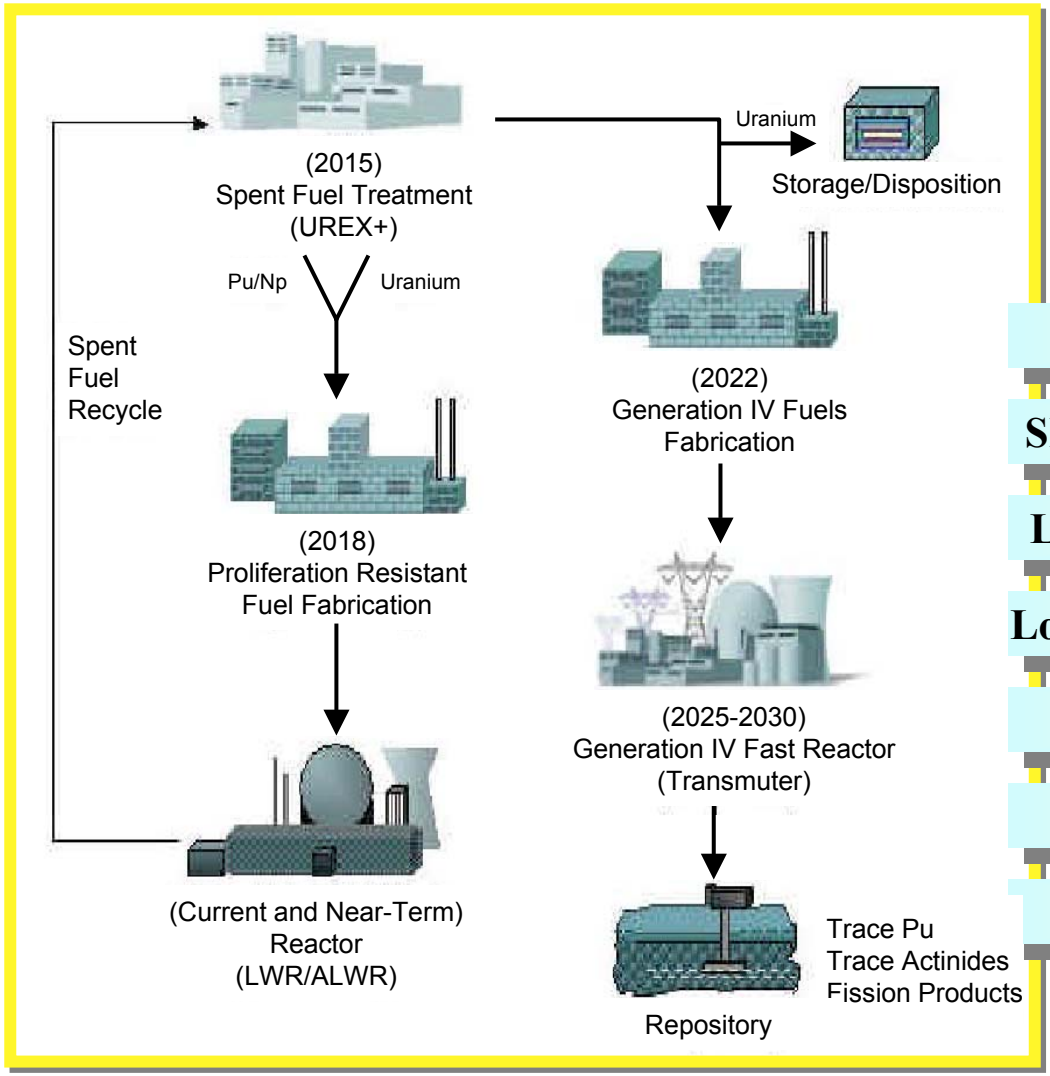


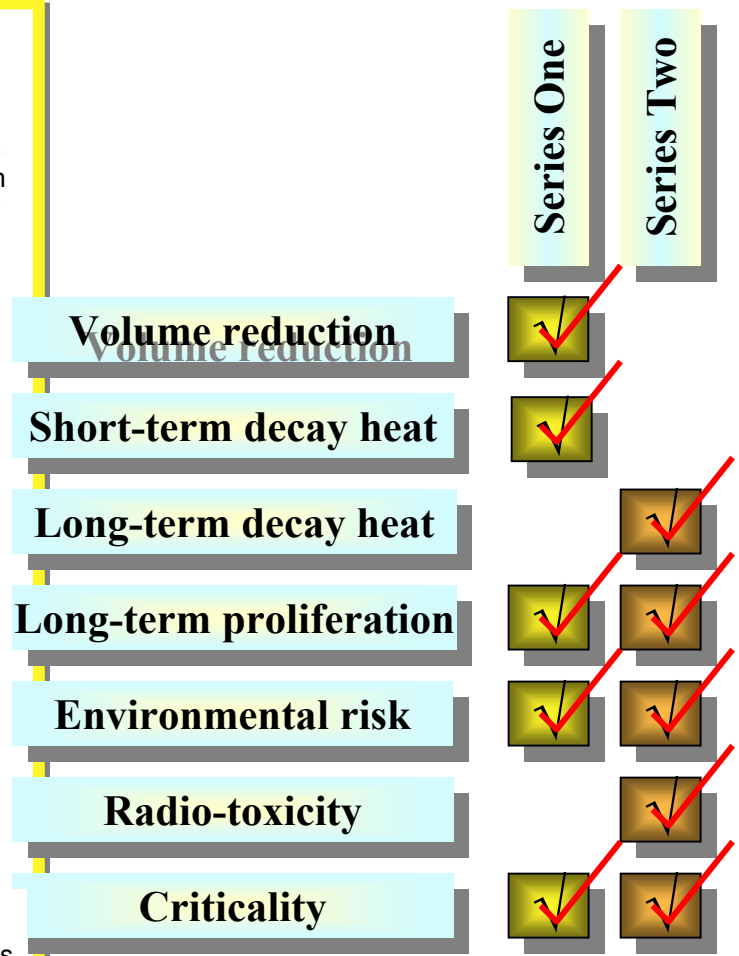
AFCI Goal - Reduce Toxicity of High-Level Nuclear Waste



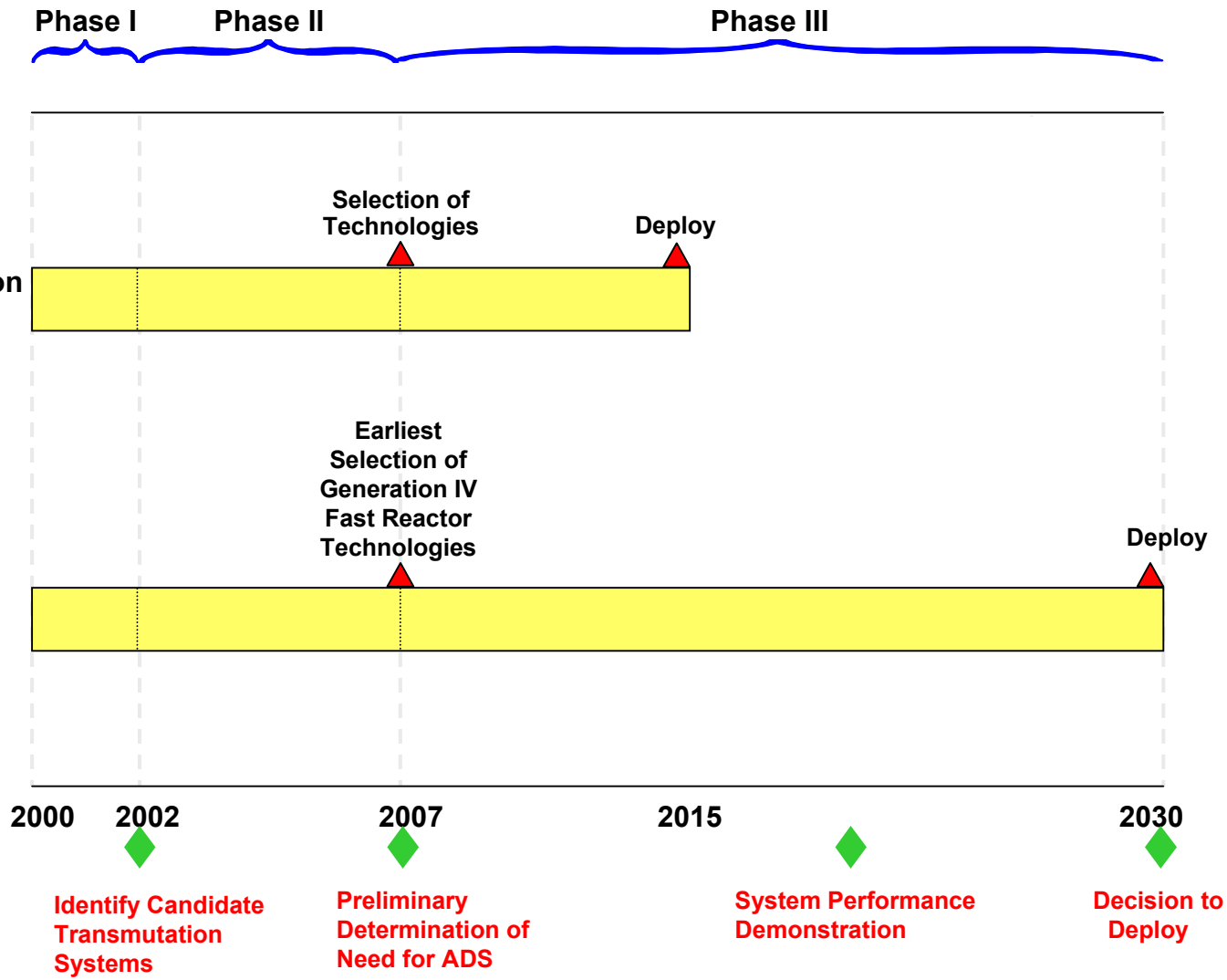
AFCI Development Program

Series One and Two Benefit Comparison





AFCI General Schedule



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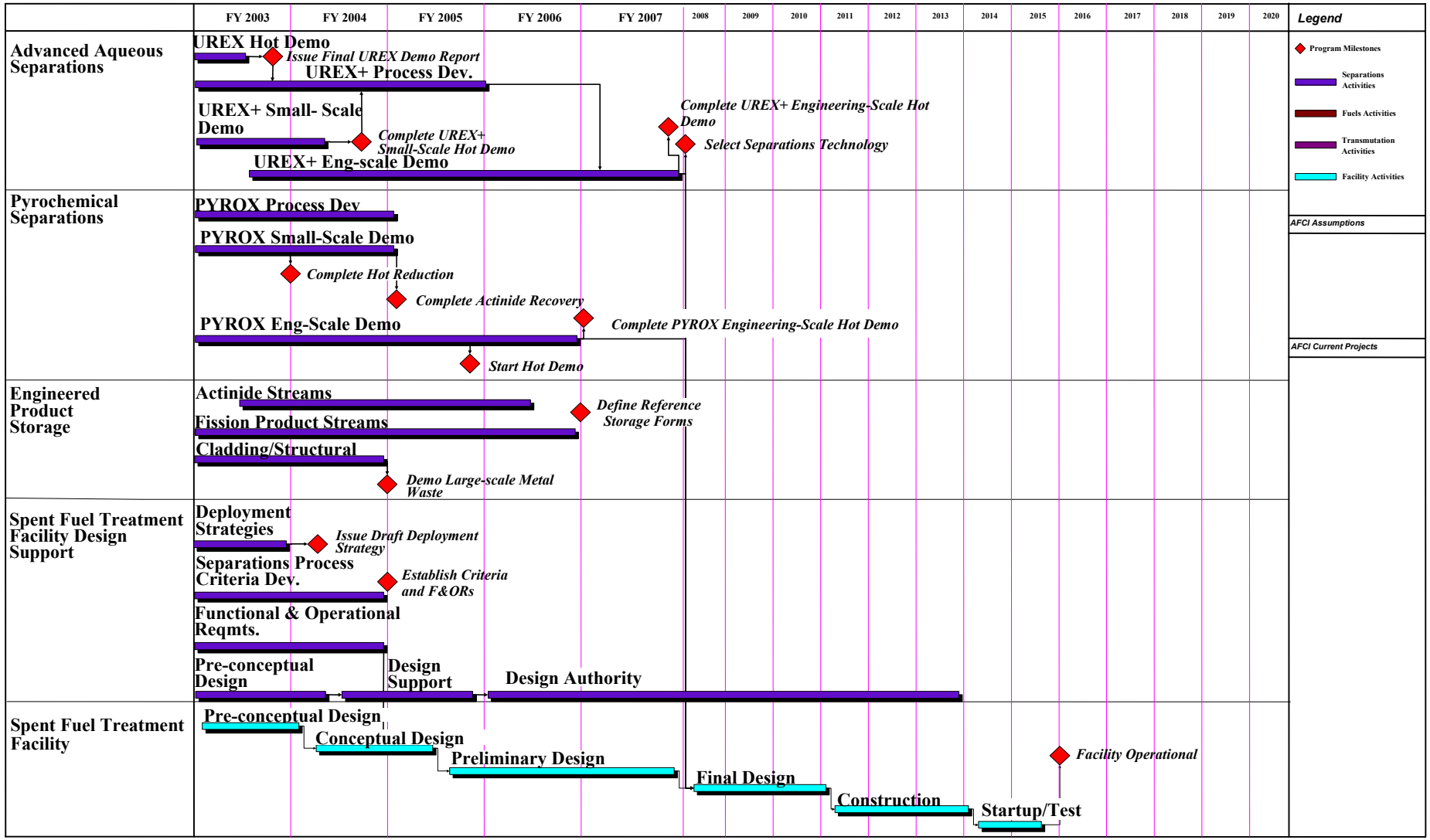
Separations Series One



Completed Accomplishments to Date (Phase I -- Basic Technology Evaluation)

- **System Studies Completed -- Technical Options Narrowed Considerably**
- **Proliferation Resistant Technology Development**
  - Separations - UREX demonstration of uranium separation at 99.999% purity
  - Nitride and metal fuels fabricated for irradiation testing
- **International Cooperation has provided U.S. with $100M in research and experimental data**
  - France - CEA
  - EU - MEGAPIE Support
  - Russia - Lead-Bismuth Test target, UNLV cooperation
- **AAA Fellowships**
  - 20 fellowships awarded to M.S. students working in areas related to transmutation. Ph.D. fellowships will be added in FY 2003.
- **UNLV**
  - Established major research program to support transmutation R&D and generate new scientists/engineers

Phase II - Proof of Principle: *Two Parallel Paths (5-6 Years R&D) to Provide Information for Decision Makers*

- **AFCI Series One - Intermediate term (2015) - using current reactor technology management**
  - Reducing high-level waste volumes
  - Optimizing economics and performance of the planned geologic repository
  - Reducing the technical need for a second repository
  - Reducing long-term inventories of plutonium in spent fuel
  - Enabling the proliferation-resistant recovery of the energy contained in spent fuel
- **AFCI Series Two - Long term (2030) - using fast reactor technology**
  - Reducing the toxicity of spent nuclear fuel
  - Reducing the long-term heat generation of spent nuclear fuel
  - Providing a sustainable fuel source for nuclear energy
  - Supporting the future operation of Generation IV nuclear energy systems

Phase III - Proof of Performance:
(15-20 years)

Series One

- Commercial Spent Fuel Treatment Facility
  - Final Design, Licensing and Operation
- LWR Lead-Test-Assembly Evaluation
- Commercial (LWR/ALWR) Fuel Fabrication Facility
  - Final Design, Licensing, and Operation
- International Collaboration Will Off-set Costs

Series Two

- Decision (2007) on Final Transmutation Technology -- (Fast Reactor, Accelerator Driven Systems, or both => Determines Testing Program
- Engineering Scale Demonstration of Advanced Pyroprocessing
- Demonstration Fuel Fabrication Facility
  - Design and Operation
- International Collaboration

Resulting Outcome of Successful AFCI Program

- Eliminate the technical need for a second geologic repository
- Confirm advanced fuel cycle designs required for successful deployment of Generation IV nuclear energy systems
- Potential cost savings of $35-50 billion -- Repository

Backup Information

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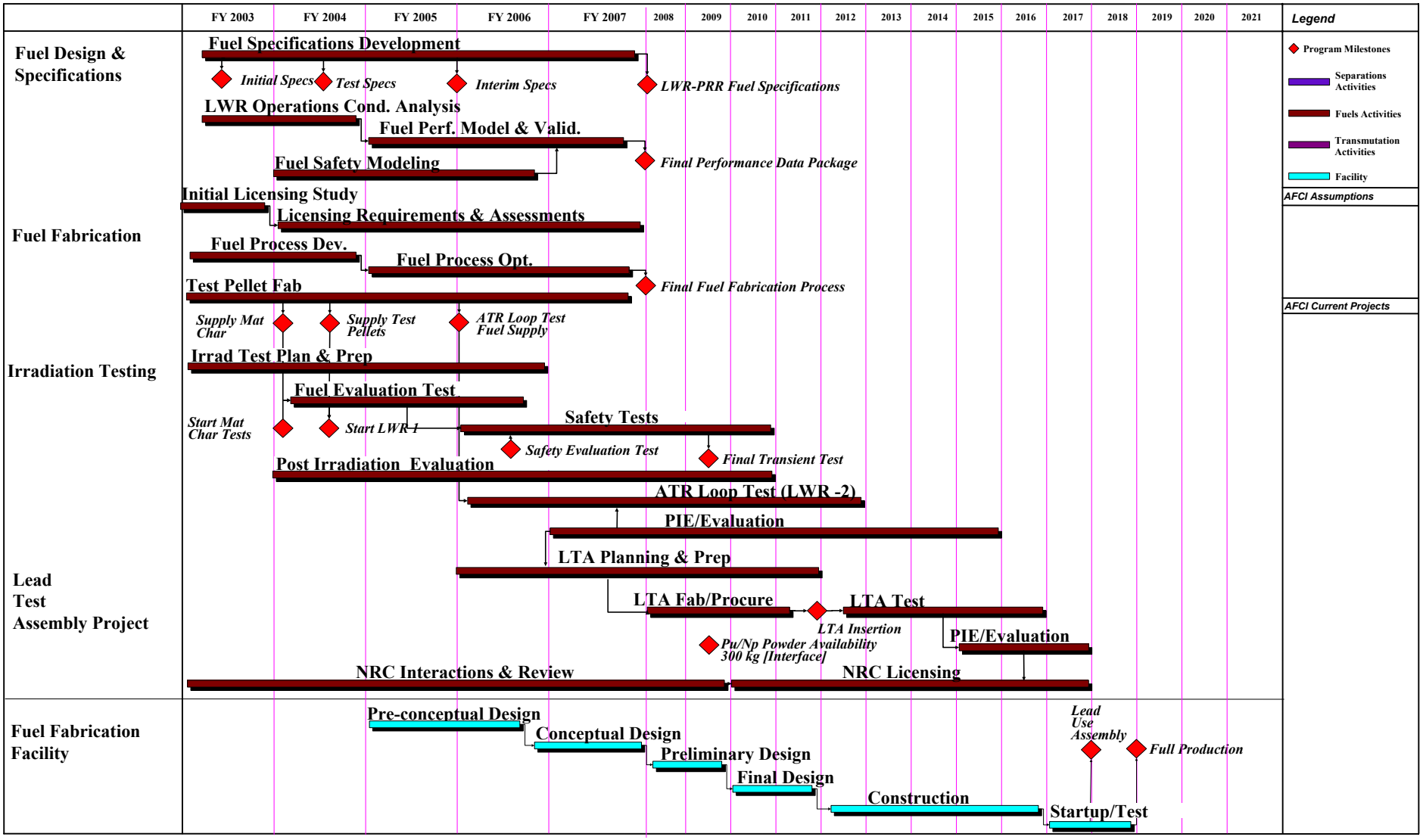
Fuels Series One



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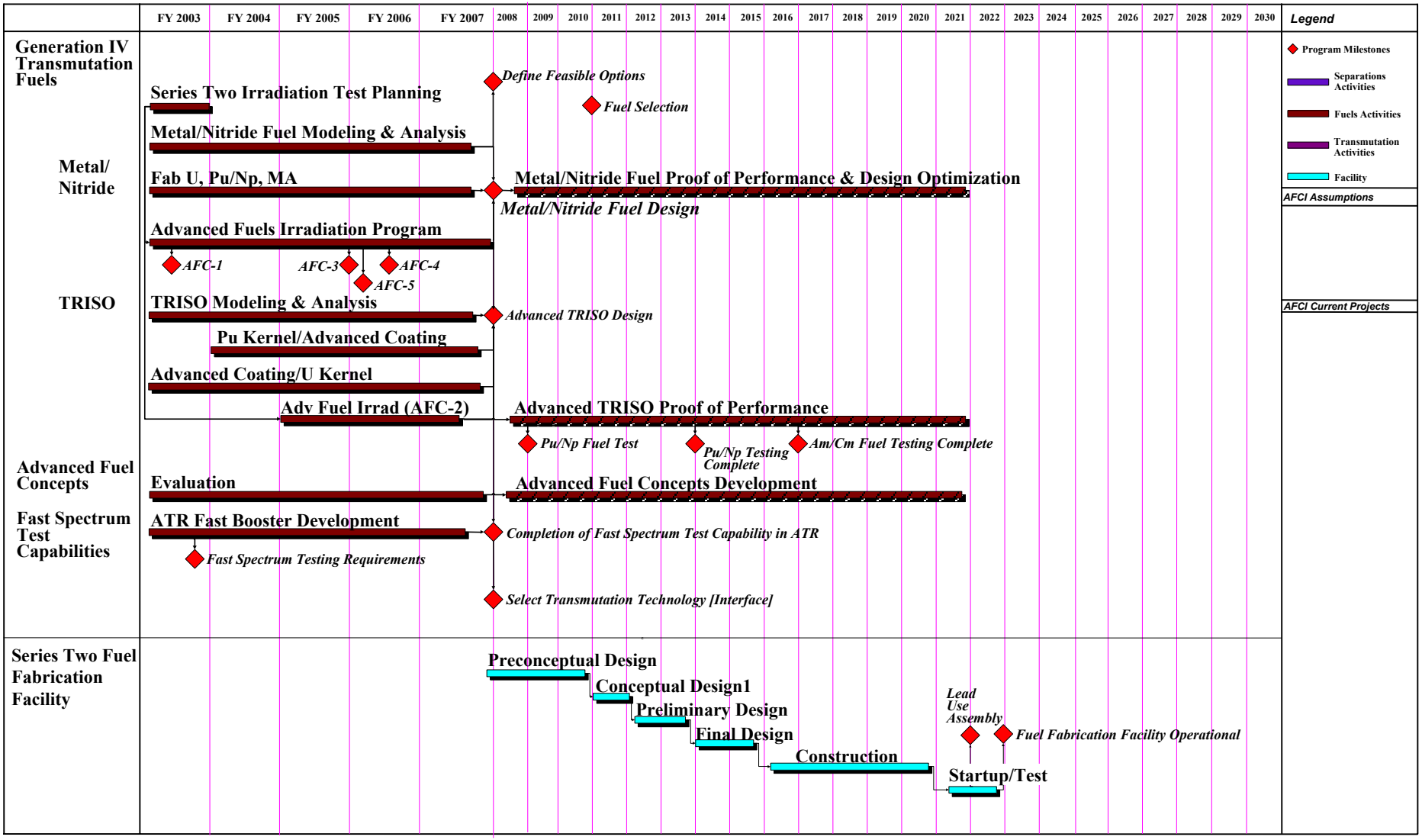
Fuels Series Two



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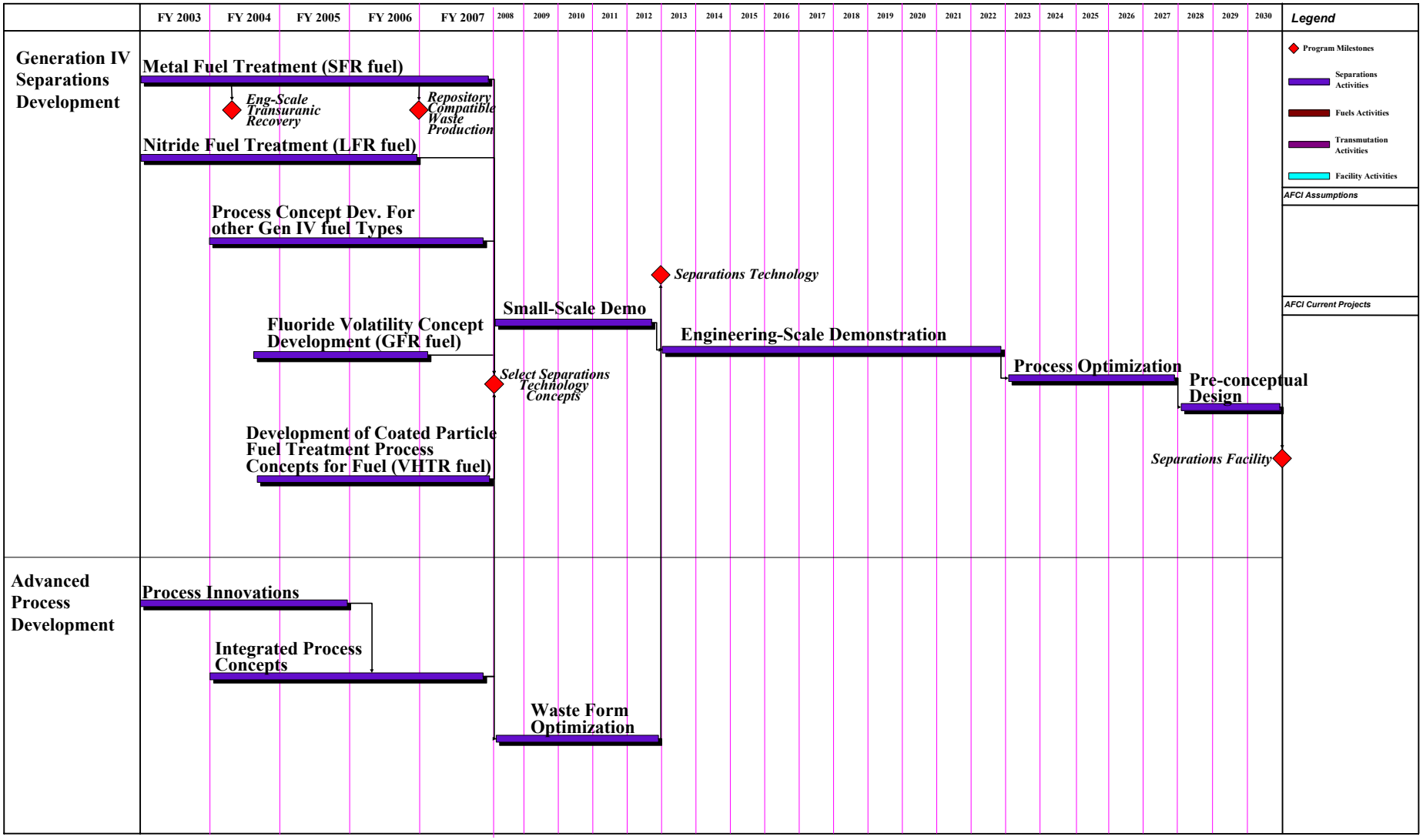
Separations Series Two



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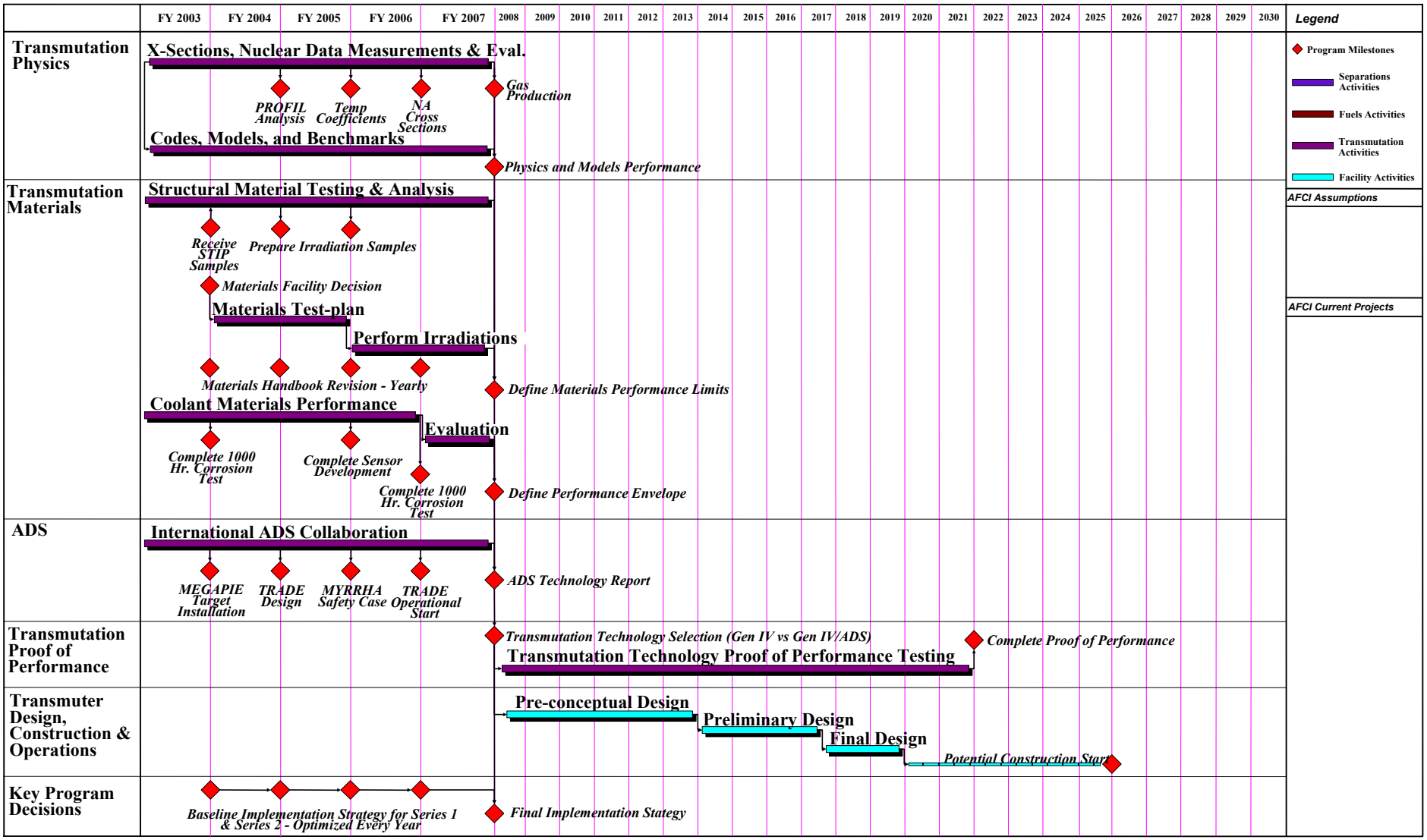
Transmutation

Rev. 0 - Pre-decisional Draft
Updated 10/09/2002



NOT USED

Phase III - Proof of Performance:
(15-20 years)

- **Follows Phase II decision point**
- **Demonstration to include:**
  - Processing
  - Separations efficiency
  - Fuel Fabrication
  - Proof of Operability
- **Strong international participation - Russia, France, Japan, European Union**